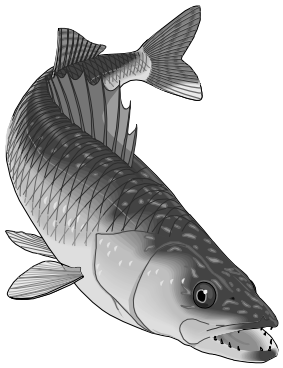
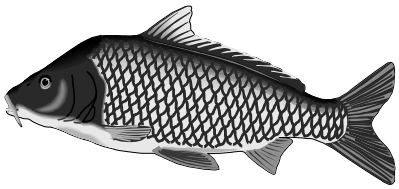
# Minor Species



## Walleye

The walleye is one of the fish being evaluated at KSU for its potential as an aquaculture species. Walleye is one of the most important commercial and recreational fish species, and a popular food fish in the north-central United States and Canada. The commercial walleye aquaculture industry currently produces fingerlings for stocking public and private lakes, but has potential to eventually supply larger food size fish for retail markets and restaurants. The climate in Kentucky appears to be well suited for pond production of coolwater fish such as walleye. Production of 1.0 pound walleye should take approximately 30 months in ponds in Kentucky according to growth rates found in research at KSU. Walleye appear to require relatively high protein levels so feeds containing, greater than 40% protein and 10% fat diets should be fed. It was observed that walleye appear to be sensitive to temperature fluctuation and high light intensity, as determined by lack of feeding activity with changing weather patterns and bright sunny days. Larger, deeper ponds (greater than 0.5 acres, greater than 5 feet deep) may reduce this effect as temperature would change more slowly and light intensity would be reduced. Also, feeding is best at dawn and dusk. Walleye are amenable to high density culture. However, average size at harvest may be increased at lower stocking densities. Walleye also appear to have slow growth in the third season grow-out as compared to the second. This may indicate that third-year walleye have passed their rapid growth phase and are becoming sexually mature. Refinement of culture methods and domestication would likely reduce the time required (a reasonable goal would be 30 months) to produce harvest size fish.

(See appendix for recommended publications on Walleye)



## Common Carp

Common carp is the main aquaculture species in many European and Asian countries. This fish has several advantages that made it so popular for commercial culture: a) very fast growth rate, b) high tolerance and easiness to handle, c) ability to be reared in high density and to give high production per square unit, d) ability to utilize prepared diet with relatively low content of protein, and e) occurrence of highly productive strains and breeds reared during a long-term process of selection and domestication. Most carp is sold on the market as live fish or as whole carcass.

In contrast to many other countries, common carp is not a popular edible in the United States. The main obstacle for acceptance of carp as edible fish in the United States is the presence of many intramuscular bones in the muscles. U.S. consumers do not like to eat fish meat with small bones and prefer boneless fish fillet.

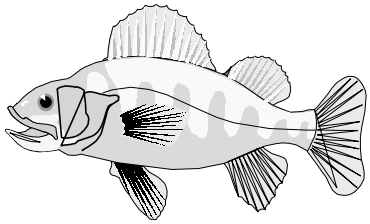
Possibly, a change in consumers' attitudes to carp may be achieved by application new types of carp meat processing. The following is suggested:

a) The using of fillet-machine which cuts the bones. Such machines for producing filets have been constructed recently and now are being used in several European countries.
b) Process carp meat by smoking and retort (canning) using special recipes (using tomato sauce, etc.) as is used in some European countries.

It is possible to initially develop optimal ways of carp meat processing by using fish caught from natural reservoirs and lakes in Kentucky. If market development proved successful, information on commercial rearing of carp in ponds is well developed and could be used immediately.

Forty percent of the world aquaculture production is from carp species. An export market for Kentucky raised carp may be possible.

(See appendix for recommended publication on Common Carp)

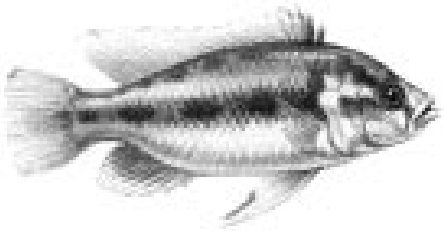


## Yellow Perch

The yellow perch is a highly valued food fish in the north-central region of the United States. Commercial harvests of yellow perch from the Great Lakes and Canada have failed to keep pace with market demands. This has resulted in high market value (up to $12 per pound for fillets, retail). Consumer demand for yellow perch has generated interest in the development of economical cultural methods. The yellow perch is considered a coolwater species. A recent study at Kentucky State University demonstrated that the optimum temperature for growth of yellow perch to be 75°F, closely matching summer (June - October) water temperatures in ponds in Kentucky. Previous research at KSU with yellow perch has also indicated that high stocking densities may be advantageous by stimulating feeding activity therefore allowing for maximum growth. Yellow perch may have potential for use under cage culture conditions.

Yellow perch should be fed a high quality floating diet containing approximately 40% protein and 10% fat and should be fed to satiation twice daily. Yellow perch are amenable to pond culture and should be considered as a species having culture potential in Kentucky. Pond production of yellow perch should take approximately 18 months to harvest size (0.25 pound) in Kentucky. Fingerling costs are high when dealing with genetically small fish such as yellow perch; for example yellow perch fingerlings cost $0.25. If four fingerlings are required to produce one pound of fish at harvest, fingerling costs would be $1.00 per pound of yellow perch produced. Processing costs would also be higher. Some obstacles related to the culture potential of yellow perch in Kentucky are that markets within Kentucky are currently limited, mainly due to a lack of consumer awareness. Also, yellow perch are not indigenous to most of Kentucky and the Department of Fish and Wildlife are concerned about the potential of introducing yellow perch in public waters.

(See appendix for recommended publications on Yellow Perch)



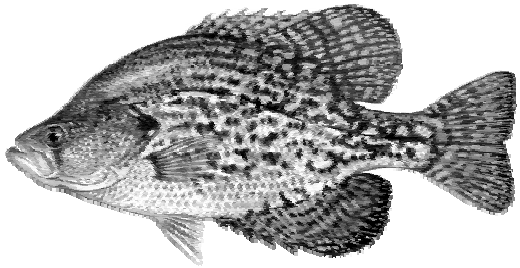
## Tilapia

Several species of tilapia and their hybrids are farmed throughout the world. The blue tilapia (*Tilapia aurea*) is a species commonly farmed in the United States. There is evidence to suggest the Egyptians raised tilapia in ponds over 3000 years ago. Tilapia are also called "Saint Peter's Fish" because it has been said that they were the fish Peter caught when Christ told him to cast out his nets in the Sea of Galilee.

Tilapia have several attributes which make them attractive as a culture species: high tolerance of poor water quality and crowding, good performance on commercial catfish feed (32% protein), a high degree of disease resistance, and a mild flavored, white flesh. Because of their tolerance to crowding and poor water quality, tilapia are well suited to cage culture and recirculating systems. Research has also shown that in addition to controlling filamentous algae, tilapia stocked in channel catfish ponds can help control off-flavors by eating blue-green and other large planktonic algae.

Tilapia have a good growth rate. A 2 to 4 ounce tilapia fingerling can reach 3/4 pound. by the end of a temperate growing season. Tilapia performance is best in a temperature range of 72-90ºF. Growth and feeding slow when water temperatures drop below 70ºF. However, tilapia are cold intolerant and die when water temperatures are lower than 45-55ºF. Blue tilapia will survive in lower water temperatures (above 45ºF) than most other species of tilapia. The pond production season in Kentucky would begin in late April and end just before the middle of October. Therefore, tilapia marketing would be seasonal and within a week or two of the same time each year. Indoor culture of tilapia in recirculating systems could extend the growing season.

(See appendix for recommended publications on Tilapia)



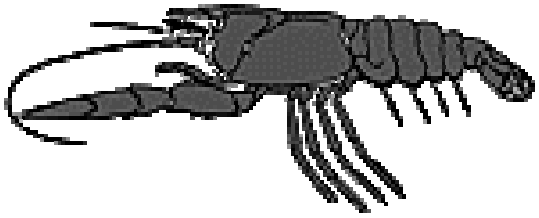
## Crappie

Black and white crappie belong to the family of sunfishes. Crappie are popular game fish in many parts of the United States including Kentucky. These fish are being evaluated as candidates for commercial aquaculture due to the following criteria: strong consumer recognition and acceptance (black and white crappie are highly-prized panfish in many states), good growth rate in optimal conditions, trainability to prepared diets, and ease of spawning in captivity.

The principal obstacle to commercial culture of crappie involved their high rate of reproduction which often leads to overcrowding and stunting. Both black and white crappie reach sexual maturity at the age of one year and can spawn repeatedly in production ponds. The presence of large numbers of small fish in ponds decreases the effectiveness of prepared diet utilization, and causes stunting.

To allow successful use of crappie in commercial production, methods for preventing uncontrolled reproduction are being developed. This may be achieved by rearing mono-sex progenies obtained by means of genetic methods (induced gynogenesis and sex reversal). The investigations of this have been initiated recently at the Aquaculture Research Center of KSU.

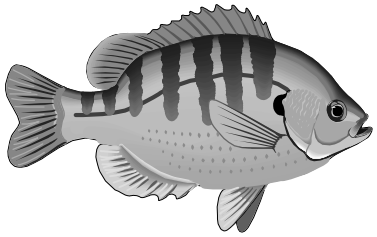
(See appendix for recommended publications on Crappie)



## Red Claw Crayfish

Red claw crayfish (Australian crayfish; *Cherax quadricarinatus*) should be very similar in culture methods and economic data to the freshwater shrimp (*Macrobrachium rosenbergii*) that are described in a prior report. However, there are several differences. One difference between the two species is that red claw will, at the present time, cost more for stocking-size individuals, due to the location (Belize) of the hatchery. Individuals in the U.S. who sell red claw generally produce small numbers of individuals (200-1000) and these are not sufficient numbers to stock even a small pond. Another difference is that red claw can spawn in freshwater, not seawater as the freshwater shrimp does. Thirdly, red claw do not undergo larval stages like freshwater shrimp and can eat a pelleted diet after being released from the female. These last two characteristics of red claw make them easier for a producer to establish his/her own hatchery. A drawback to red claw juvenile production is their much lower fecundity rate compared to the freshwater shrimp. Red claw females generally produce from 100 to 1000 juveniles per female; however, survival is high because they do not have larval stages. A fifth difference between the two species is that red claw can be sold to the aquarium industry where they are highly desired because of their colorful shell. Aquarium industry can pay a supplier up to $2 per inch for a small (1-3 inches) red claw to be sold as an aquatic pet. A sixth difference is that red claw can tolerate somewhat cooler water temperatures than the freshwater shrimp so that the growing season could be increased. However, like the freshwater shrimp, red claw die when water temperatures decline to 50$^{o}$F; therefore, they should not pose a threat to native crayfish species in Kentucky, nor do they burrow. Lastly, red claw can be grown in tanks somewhat more easily than the freshwater shrimp due to its less cannibalistic nature if shelters are provided. Red claw offer another alternative for Kentucky producers who desire to grow them and/or start a hatchery operation.

(See appendix for recommended publications on Red Claw Crayfish)



## Hybrid Bluegill

In recent years the interest in culture of bluegill hybrids has increased greatly. Much of the attention has been focused on the hybrid produced when male bluegill (*Lepomis macrochirus*) are crossed with green sunfish (*L. Cyanellus*). This hybrid has been singled out among the many "bream" species based on its' aggressive nature, willingness to accept artificial diets, and skewed sex ratio (greater than or equal to 90% male). This has resulted in substantial production for stocking into recreational ponds. In Kentucky hybrid bluegill have been evaluated, and show promise, for use in pay lakes (fee fishing). In the north central region of the U.S., hybrid bluegill have also been identified as a species of primary interest for food fish production.

Compared to other interspecific hybrids, such as hybrid striped bass, hybrid bluegill are relatively easy to produce. No hormone treatments are required and pond spawning is relatively productive and reliable. One of the most important factors in the production of hybrid bluegill is proper identification of both sexes used in the cross. Improper sexing of even one or two fish can ruin the production of an entire pond.

Bluegill males need to be at least two years old and greater than or equal to 1/4 pound in size. Green sunfish females may be much smaller. Broodstock are normally stocked in late winter or early spring at 20-40 pairs per acre. Sex ratios are normally 1:1. Ponds should be filled at least 2-4 weeks before broods are stock. It is essential that no other fish are present in the pond at stocking. The pond should be fertilized to produce a plankton bloom. Providing areas around the edge of the pond with fine gravel, or even gravel in nesting boxes may proved beneficial.

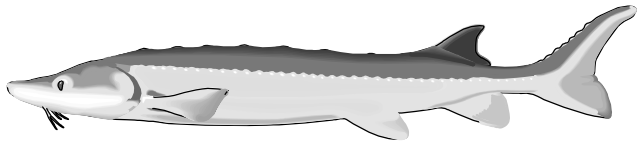
Spawning usually occurs at 78-80°F. Fry should be observable soon after hatching. Broodfish may be selectively removed by using a large mesh seine (based on brood size). A powder trout starter diet should be fed around the edges of the pond. Once feeding is observed particle sizes can be increased accordingly. Approximately 100,000 fry per acre may be produced. Fingerlings can reach a stocker size of 2-3 inches in 60-100 days. Transport of 2-3 inch fish is usually less stressful once temperatures cool in the fall. For pond stocking fish are now ready to sell. Wholesale price for 2-3 inches hybrid bluegill is approximately $0.05 each with retail prices of $0.25-$0.40 each.

For use in pay lakes, or possibly as a food fish, at least a second year of growth is required. Fingerlings are thinned or stocked in the fall or spring at 5,000-10,000 fish per acre. These fish are fed all

they will eat of a floating trout or hybrid striped bass diet of 36-42% protein. Based on research at Kentucky State University approximately 3,000 pounds per acre of fish averaging 1/3 pound each can be produced during this second year.

Field trials of this size of fish in pay lakes indicates excellent acceptance by customers and allows the pay lakes to diversify their offerings. One cooperating pay lake operator stated a willingness to pay $2.50 per pound for 1/3 pound hybrid bluegill. Their potential as a food fish has not been well investigated but is being researched in the north central region.

(See appendix for recommended publications on Hybrid Bluegill)



## Sturgeon

Sturgeons are found only in the northern hemisphere. Like the paddlefish, sturgeon are without bones and the processed roe (caviar) is highly valued. Of the 26 sturgeon species found in the world, the main sources of caviar for global demand are only from four sturgeon species from the Caspian Sea: beluga (*Huso huso*), Russian sturgeon or osetra (*Acipenser gueldenstaedti*), stellate or sevruga (*A. stellatus*) and ship (*A. nudiventris*). Reports have shown that there is a major decline in sturgeon stocks within the Caspian Sea. Farming technologies have been established for some commercially valuable species. Sevruga and Russia sturgeons are being farm-raised in ponds in Europe. In the United States, white sturgeon have been farmed-raised on one farm in California which has recently begun to market meat and caviar. The farming system uses a recirculating system requiring feeding prepared diets, intensive management, and high capital and operating costs, especially for mature females for production of caviar. Shovelnose sturgeon, found in the Mississippi drainage, have recently drawn much attention as a domestic caviar in the United States. The use of Russian sturgeon that can be farm-raised in ponds and co-exist with other fish species should be evaluated in Kentucky.

(See appendix for recommended publications on Sturgeon)

## Aquatic Plants

Aquatic plants are grown commercially for food, aquariums, water gardens, and wastewater management. The largest aquatic plant crop in the world is rice. Watercress is a common species of water plant, native to the United States, which is produced for consumption as food. There are many large Asian communities in the United States which form lucrative specialty markets where such aquatic plants as water chestnut and aquatic spinach are sold.

In 1992, the market for aquarium plants was estimated at $16-$20 million per year. There are several species that are farmed, including elodea and valisineria. However, the market is dominated by national wholesalers. These large wholesalers sell to regional wholesalers, who in turn, sell to local retailers.

A multi-million dollar, nationwide industry which services and supplies water gardens have sprung up in the last decade. Water gardens have become very popular in residential areas where individuals have large discretionary incomes. Combining flowering and exotic aquatic plants with colorful fish (koi and goldfish) creates what Asian civilizations have cultivated as "living art." Water gardens are popular because they provide the modern urban dweller with a private and relaxing backyard environment for meditation and reflection.

A water garden can be made in a whiskey barrel or a pond as large as the landscaper desires. The cost of an aquatic garden can range from one hundred to several thousand dollars. Many of the more popular water garden plants are species which are native to Kentucky; for example, water lilies and lotuses (which are farmed in ponds) and bog plants.

These new urban and residential markets may offer future opportunities for Kentucky's water farming entrepreneurs. However, several of the species marketed are exotic plants and/or are considered to be nuisance and weed species in natural waterways, ponds, lakes, and reservoirs. There may be restrictions on the culture of imported aquatic plants and controls must be in place to prevent weed species, native and exotics, from entering public and natural waters.

(See appendix for recommended publications on Aquatic Plants)